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Research Progress of Surface Penetrating Radar Applications in Lunar and Deep Space Exploration

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Surface Penetrating Radar (SPR) originated a patented technology in the study of buried characteristics by German scientists in the early 20th century. So far, SPR is the only non-destructive testing method that can penetrate the surface of planets to find the subsurface water-ice, and it's also the most eligible geophysical method to image the subsurface geological structure due to the electromagnetic discontinuity for planetary exploration.
In 1972, the Apollo17 mission pioneered the use of SPR technology in lunar exploration, and for the first time Apollo Lunar Sounder Experiment(ALSE) detected the dielectric properties of the lunar subsurface using high-frequency electromagnetic waves. Thirty years later, SPR technology has been successfully applied to Lunar and Mars exploration by remote sensing observations and in-situ measurements. The JUICE Mission will inherit the successful experiences of Mars exploration, the radar sounder will be used to investigate the liquid oceans under the icy moons of the Jupiter. In the next few years, ExoMars 2018 and MARS 2020 rovers will arrive on the surface of Mars for the subsurface in-situ measurements.
The main applications of SPR in Lunar and Deep Space Exploration are:
i.To survey the subsurface geological structure;
ii.To investigate the distribution of solid and liquid water in the upper part of the shell;
iii.To explore the Ionosphere;
iv.To survey the internal structure of asteroid or comet.